R-2500 MANUAL REFRACTOR

User's Manual

LUXVISION®
PRECISION INSTRUMENTS

Notification

Dear Users,
Thank you for your purchase of R 2500 Refractor. Please take time to read our user's manual carefully before use.
This guarantees you to make full use of this unit and prolongs the operation life of this unit.

Content

1. Standard equipment

1. Main body of instrument (1 set)
2. Near point scale (1 pce)
3. Near point chart holder (1 pce)
4. Rotating near point chart (1 pce)
5. Accessory case (1 pce)
6. Air brush (1 pce)
7. -0.12C auxiliary lenses (2 pcs)
8. -2.00C auxiliary lenses (2 pcs)
9. Silicon cloth (1 pce)
10. Dust cover (1 pce)
11. Sanitary face shields (1 each right and left)
12. Fitting screw (1 pce)
13. Polystyrene case (1 pce)

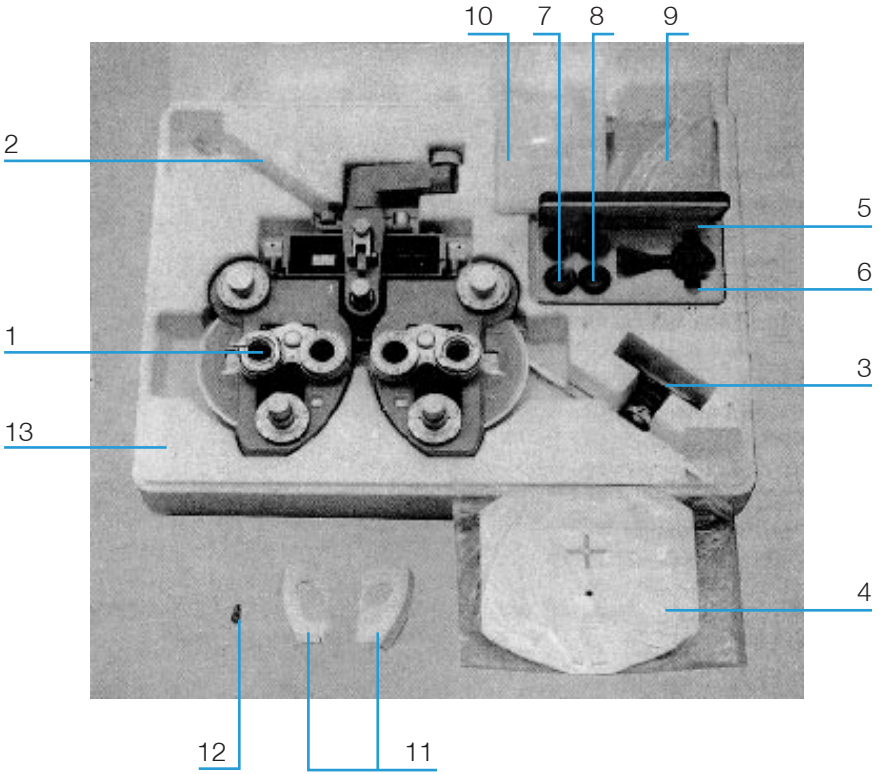


Fig. 1

* The polystyrene case should be retained for use when sending the instrument back to the representative or manufacturer for overhaul, etc.

2. Subjective Eye Tester

A. New levelling mechanism

B. Fingertip adjustment for sphere power control

Just the right figure from 0 to ~19.00D and 0 to +16.75D obtained with light, fingertip control of the fast feed dial. Optional ±10.00D lenses are also available.

C. Measuring astigmatism

Readings 0 to - 6.00D, which become possible up to - 8.00D with the accessory lenses -2.00D. Used in combination with the cross cylinder for precision measurement.

D. Cross cylinder (±0.250)

Tests are speeded up by eliminating, the need for axis adjustment, a very efficient synchronizing mechanism being provided and the loupe is readily turned by means of the knob.

E. Rotary prism

The wider 1Δ D spacing in the 20Δ D range simplifies reading and incorporation into the main body of the instrument means that a maximum field of view is obtained.

F. Unique new convergence system mechanism

Convergence lever control for precision near point readings.

G. Wide range of auxiliary lens combinations (See details on the page 6)

H. Precision machined to finest tolerances

The use of top quallity bearings and elimination of the need for periodic lubrication.

3. Names of Parts

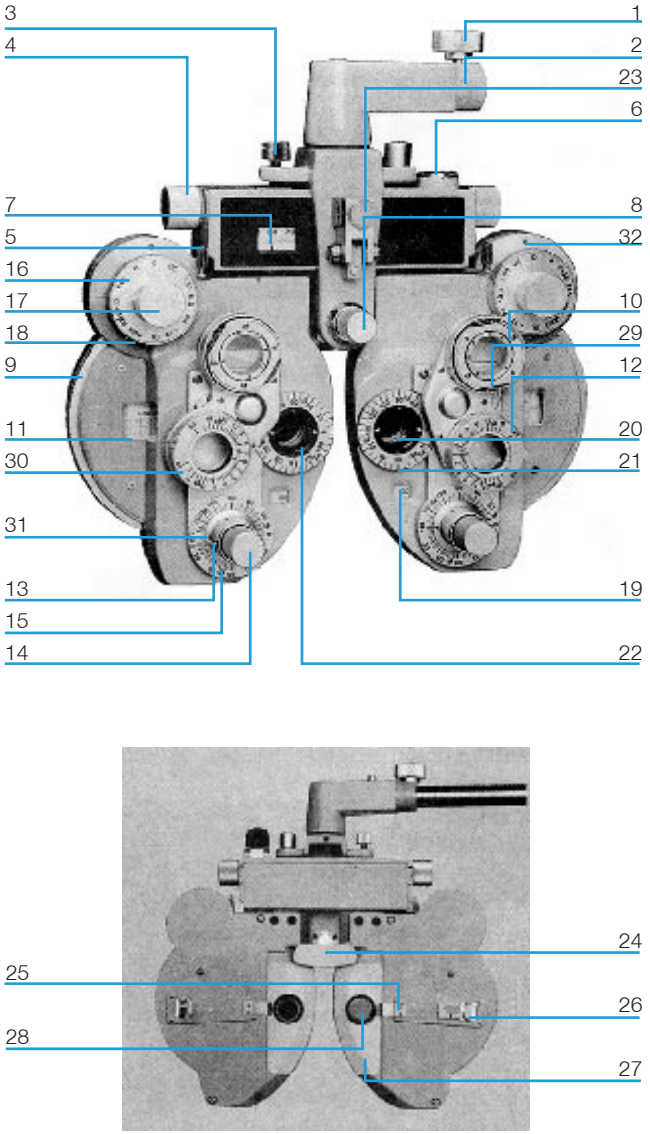


Fig. 2

1 Locking knob
2 Clamp bracket
3 Levelling knob
4 Interpupillary adjustment knob
5 Convergence lever
6 Level
7 Interpupillary scale
8 Forehead rest adjusting knod
9 Sphere power control ring
10 Cross cylinder
11 Sphere power reading window
12 Rotary prism
13 Cylinder lens axis control ring
14 Cylinder lens power control knob
15 Cylinder lens axis scale (A)
16 Sphere power rapid feed dial
17 Auxiliary lens control knob
18 Auxiliary lens symbols
19 Astigmatism scale
20 Cylinder lens axis index
21 Cylinder lens axis scale
22 Accessory lens pinhole
23 Near point scale receiver
24 Forehead rest
25 Corneal foresight
26 Corneal backsight
27 Sanitary face shield
28 Main aperture
29 Cross cylinder rotating knob
30 Rotary prism knob
31 Astigmatic axis index
32 Auxiliary lens mark

4. Details of Auxiliary Lenses

12 Kinds of auxiliary lenses can be set at each main aperture on right and left sides.

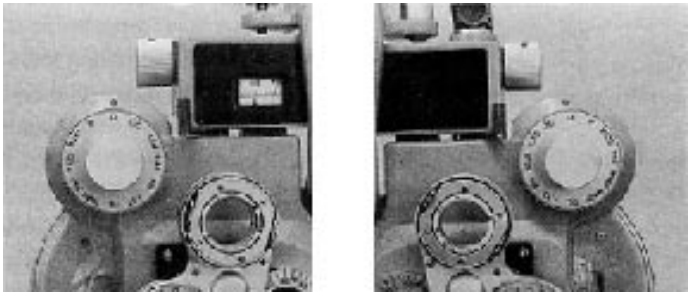


Fig. 3

O .....Open aperture
OC .....Occluder
±.50 .....+0.50 cross cylinder
6Δ U ..... 6 prism diopter base Up
10Δ I .....10 prism diopter hase In
PH .....Pinhole
+ 12 .....+ 0.12D auxiliary lens
PL .....Red filter
GL .....Green filter
RMH .....Red maddox rod, horizontal
WMH .....White maddox rod, horizontal
RMV .....Red maddox rod, vertical
WMV .....White maddox rod, vertical
P135°.....Polarizing filter, axis 135°
P45°.....Polarizing filter, axis 45°
R .....Retinoscopic lens, +2.00D (for 50cm)

5. Measuring Performance

A. Provides highly accurate readings over a wide range.
Used in measurements of Myopia, Astigmatism, Hyperopia, Presbyopia, Heterophoria. Range of Accommodation, Convergence, Aniseiconia, Stereopsis and Binocular Vision.

B. Rapid, accurate readings on binocular visual balance

C. Speedy astigmatism tests
With interlocking mechanism of the cross cylinder lens axis and the cylinder lens axis control ring, one touch accurate astigmatism readings are now possible.

D. In short, middle and long distance tests, it is possible to have the optical axis of the lens and the line of examinee's vision coincide.

6. Preparation Before Eye Testing

A. Have the examinee sit on an eye examination chair.

B. Adjust both readings in the sphere power reding window (11) and astigmatism scale (19) to 0.00. (Fig. 4)

C. Adjust the interpupillary scale (7) setting to the interpupillary distance of the examinee. (Fig. 5)

D. Level the instrument with the levelling knob (3) while watching the level (6). (Fig, 6)

E. Align the examinee's eyes with the right and left main apertures (28) and tighten the arm fixing knob.

F. Turn the forehead rest adjusting knob (8) until the scale "0" on the corneal backsight (26), the corneal foresight (25) and the vertex of the cornea of the examinee are all in a straight line. (Fig. 7)

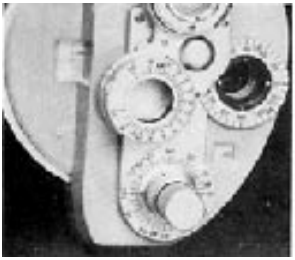


Fig. 4

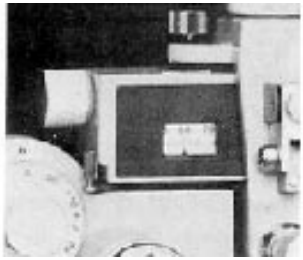


Fig. 5

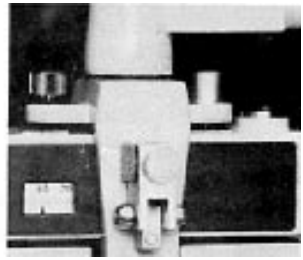
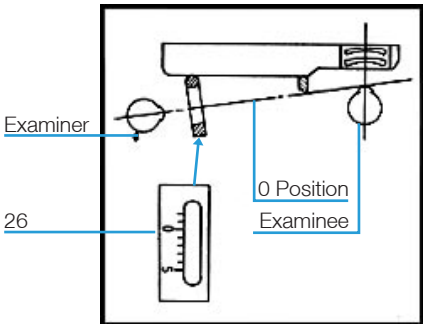


Fig. 6



(Fig. 7)
Distance from the vertex of the cornea of the examinee to the surface of the lens: 12mm

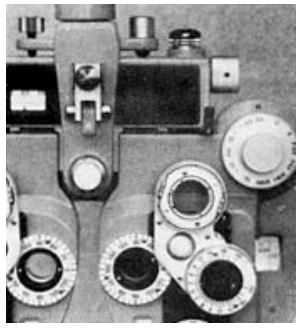


Fig. 8

7. Measuring Myopia and Astigmatism

A. Begin readings at about +3.0D in the case of an examinee with naked eye visual power around 0.5 ~ 0.6 and in the case of an examinee who wears spectacles, first find the power of the spectacles with a Lensmeter and begin readings with a figure added + 3.00D to the measured power.

B. First the right eye should be measured.
Cover the left eye. Turn the auxiliary lens control knob (17) and when the OC mark is aligned with the auxiliary lens mark (32), the left eye is covered. (Fig. 8)

C. Turn the sphere power control ring on one side and reduce 0.25D at a time (+3.00D → + 2.75D → +2.50D) until a visual acuity of about 0.5 is obtained.

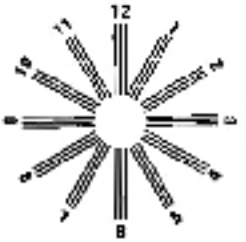


Fig. 9

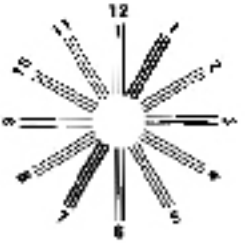


Fig. 10

D. Have the examinee look at astigmatic visual acuity chart. (Fig. 9)
If all the lines appear to him to be equally thick and dark, there is no abnormality, but if lines in one direction appear to him to be lighter or darker than the others, then he has astigmatism and proceed with the following tests.

E. Think of the astigmatism chart as the dial plate of a clock, and supposing that the examinee answers that he can see the lines pointing in the direction of "one o' clock" clearly, take 1 x 30 times = 30° and align the astigmatic axis index (31) with the 30° position by turning the cylinder lens axis control ring (13).

F. Turn the cylinder lens power control knob (14), increasing the power until all lines on the astigmatism chart appear to be of equal darkness.

G. Turn the sphere power control ring (9) until a visual acuity of about 1.0 is obtained. (Example) In case of myopia, the sphere power is — 1.75D to be minimum degree when a maximum visual acuity of 1.0 is obtained.

Sphere power	**Visual acuity**
-1.00D	0.7
-1.25D	0.8
-1.50P	0.9
-1.75D	1.0
-2.00D	1.0
-2.25D	1.0

H. Measure the left eye in the same procedure.

8. Precision Measurement of Astigmatic Axis

A. Set the cross cylinder (10) at the main aperture.

B. Turn the periphery of the cross cylinder to adjust the axis of the cross cylinder rotating knob (29) in the same direction as astigmatic axis (7-E) and set it at click-stop position.

C. Now have the examinee look at visual acuity charts about two steps lower than those which he has been able to see. For example, if he has been able to read those at 1.0 point, now have him look at those for 0.8.

D. Turn surfaces 1 and 11 of the cross cylinder (10) alternately and have the examinee look at them. If both surfaces can be seen equally well, there is no abnormality, but if one is more clearly seen than the other, carry out the following procedure.

E. Stop turn at the surface which is clearly seen, next move and shift the astigmatic axis 5° in the direction of red dots on the cross cylinder by the cylinder lens axis control ring (13).

F. When surfaces I and II can both be seen equally well after this; method is used and tests repeated two or three times, it is determination of an astigmatic axis.

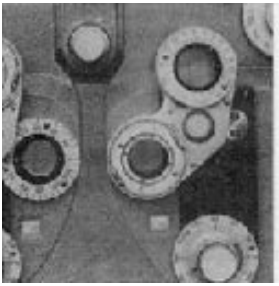


Fig. 11

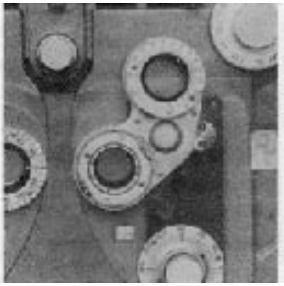


Fig. 11A

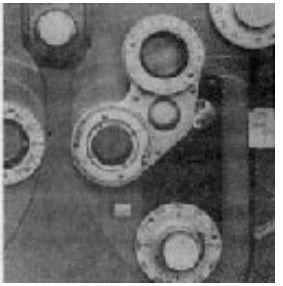


Fig. 12

9. Precision Measurement of Astigmatic Power

A. Turn the periphery of the cross cylinder to adjust the axis of the P marks in the same direction as astigmatic axis and set it at click-stop position.

B. Turn surface I and II alternately and have the examinee look at them. If both surfaces can be seen equally well, there is no abnormality, but if one is more clearly seen than the other, carry out the following procedure.

C. Stop turn at the surface which is clearly seen. Then if the P marks align with the red dots, add astigmatic power -0.25D by turning the cylinder lens power control knob (14), and if the P marks align with the black dots, decrease astigmatic power -1.25D.

D. And again turn surfaces I and II of the cross cylinder, and repeat procedures from (B). When both surfaces can be seen equally well, it is determination of an astigmatic axis.

E. Measure the left eye in the same procedure and after finished, move the cross cylinder from the main aperture.

10. Precision Measurement of Spherical Power

A. For fine adjustment of the spherical power, first the right eye should be measured with occlusion of the left eye.

B. Have the examinee look at both the red and green tests on the visual acuity chart and have him compare clearness of the black + in the red andgreen tests. If the + in both tests can be seen equally well, it shows that the corrected power is actually correct, but if either of these colors can be seen well, carry out the following procedure.

C. If the red can be seen well, increase the reading in the sphere power reading window (11) by -0.25D, and if the green can be seen well, increase the reading by +0.25D. Continue to make adjustments until both red and green tests can be seen equally well.

D. Have the examinee look at the visual acuity chart and try to obtain a maximum visual acuity that he can read.

E. Have the examinee lock at a teat where the maximum visual acuity has been obtained, and add spherical power by +0.25D.

F. If the test is out of focus, restore the spherical power to the former reading and measurements are finished now, but if in focus, carry out the following procedure.

G. Add more +0.25D and restore the spherical power where the test has been out of focus to the former reading, and measurements are finished now.

H. Measure the left eye in the same procedure.

11. Eye Balance Test

A. Have the examinee look at about 0.7 point on the visual acuity chart.

B. Set the rotary prisms (12) at the right and left main apertures (28) (Note: the rotary prism knobs (30) should be set at click-stop position on the ears' side of the examinee). Next, insert a 2Δ DBU prism in the left and a 2Δ DBD in the right. (See Fig. 13)
(The visual line from the left eye moves in the lower direction and that from the right eye moves in the upper direction.)

C. When the examinee looks at the test chart with binocular vision, he can see it split into two, an upper and a lower: i.e. the lower part in the left eye and the upper part in the right eye. If both upper and lower parts can be seen equally well, it shows that the right and left eyes are balanced. If either of the upper and lower parts can be seen well, carry out the following procedure.

D. Add +0.25D at a time to the spherical power for the eye where the test chart has been able to be seen well until both eyes can balanced.
If balance can not be obtained, try to improve the visual acuity of the dominant eye.

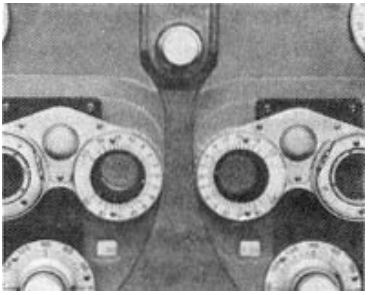


Fig. 13

12. Measuring Presbyopia

A. Make perfect correction of the refraction anomaly in distant vision and make a setting of the instrument based on the result.

B. Set a ±0.50 auxiliary cross cylinder lens in place for each eye.

C. Turn the convergence levers (5) inward.

D. Set a near point chart in a fixed place of the instrument.

E. Allow the examinee to choose the distance at which the chart is set up, and select a cross-cylinder grid on the near point chart.

Cross-cylinder grid (Fig. 14)

F. Have the examinee look at the cross-cylinder grid with both eyes to compare darkness of the vertical and horizontal lines.
For a presbyope (a range of accommodation is smaller), usually the horizontal lines will be seen darker.

G. Add the sphere powers in both the right and left sphere power reading windows +0.25D at a time simultaneously and stop this procedure when both the vertical and horizontal lines are seen equally well.
Now the spherical power for near point is determined.

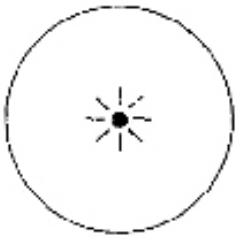
H. The value taken the distance sphere from the near point sphere is an ADD power. This is required for checking clearness at intermediate distance or prescription of a continuous vision lens.

13. Measuring Heterophoria (Horizontal)

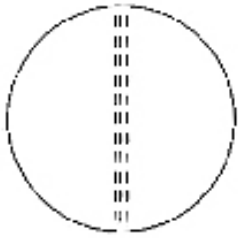
A. Project a fixation light (a point light) or a fixation point from the projector at a distance.

B. Insert the RMH auxiliary lens for the right eye and the O (open) for the left eye.

C. When seen with the right eye, the image appears as in Fig.16, and when seen with the left eye, a point light appears as in Fig.15.

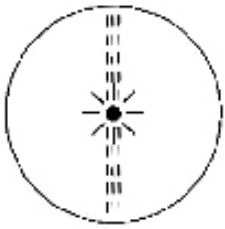


Left eye (Fig. 15)

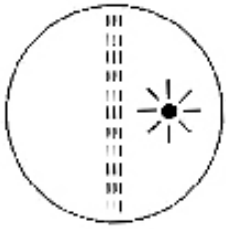


Right eye (Fig. 16)

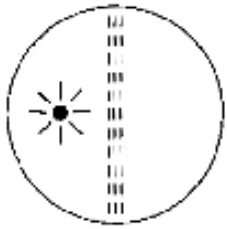
D. If there is no phoria when seen with both eyes, the two images appear as in Fig.17. If there is a horizontal phoria, the two images appear disaligned as in Fig.18 and Fig.19.



(Fig. 17)



(Fig. 18)



(Fig. 19)

E. If there is a horizontal phoria, set the rotary prism for the left eye at click-stop position in the horizontal phoria measuring direction.

F. Turn the rotary prism knob slowly until the two images are aligned as in Fig.17. The scale reading when both aligned is a degree of the horizontal phoria.

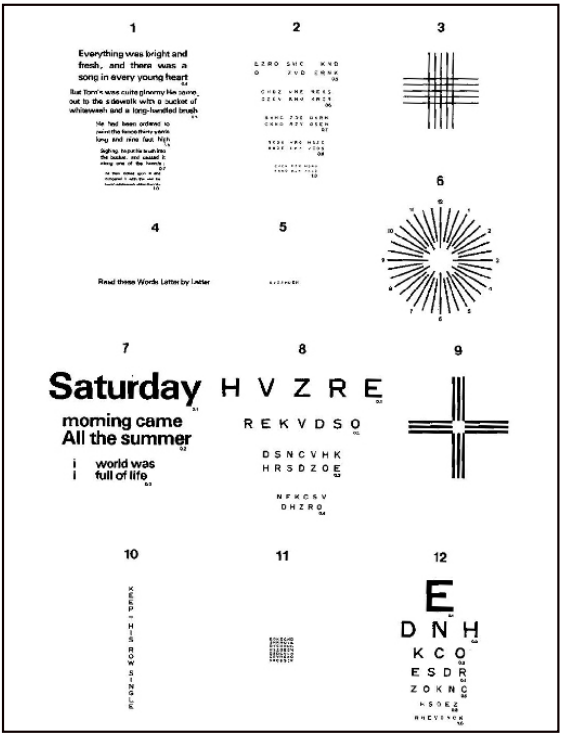
14. Measuring Heterophoria (Vertical)

Measured in the same procedure as above with use of the RMV auxiliary lens.
If used with the WMH and WMV auxiliary lenses for the left eye, also measured in the same procedure.

15. Details of Rotating Near Point Chart

The standard examination distance for this near point chart is 40cm (but, the No.12 test should be used at a distance of 70cm).

1. Sentences (0.4 - 1.0)
2. Alphabetical letters (0.5 - 1.0)
3. Cross-cylinder grid (thin lines)
4. Sentence
5. Alphabetical letters
6. Astigmatic chart
7. Sentences (0.1 - 0.3)
8. Alphabetical letters (0.1 - 0.4)
9. Cross-cylinder grid (thick lines)
10. Vertical row of sentence
11. Alphabetical letters
12. Intermediate distance chart
    (at an examination distance of 70cm)



16. Distance Compensation

If the distance between the instrument and the examinee is not as specified, distance compensation should be carried out (See 6 - (F), Fig. 7).
When the Sphere power is Plus (+):
If the distance is shorter, (-) compensation
If the distance is longer, (+) compensation When the Sphere power is Minus (-) :
If the distance is shorter, (+) compensation
If the distance is longer, (-) compensation
(Example)
If with a sphere power reading of +10.00 the distance is 5mm longer than specified, a correction should be 0.52 according to the compensation table, making +10.52D (+10.00 + (+0-52) = + 10.52).

Distance Compensation Table (with + Sphere)

PHOROPTOR Reading	Distance									
	1mm	2mm	3mm	4mm	5mm	6mm	7mm	8mm	9mm	10mm
+ 1.00	001	002	003	004	005	006	007	008	009	01
+ 2.00	004	008	01	02	02	02	03	03	04	04
+ 3.00	01	02	03	04	05	06	07	08	09	10
+ 4.00	02	03	05	07	08	10	12	13	15	17
+ 5.00	03	05	07	11	12	15	18	21	24	26
+ 6.00	04	07	10	16	18	21	26	31	35	38
+ 7.00	05	10	14	21	25	29	36	42	48	52
+ 8.00	06	13	19	27	33	39	48	55	64	70
+ 9.00	08	16	24	34	42	51	61	70	81	90
+ 10.00	10	20	30	42	52	64	75	87	99	1.11
+ 11.00	12	25	37	51	64	78	91	1.06	1.21	1.36
+ 12.00	15	30	45	61	77	93	1.10	1.27	1.46	1.64
+ 13.00	18	35	53	72	91	1.10	1.31	1.51	1.73	1.95
+ 14.00	21	41	62	84	1.06	1.29	1.53	1.77	2.03	2.29
+ 15.00	24	47	71	97	1.22	1.49	1.77	2.05	2.36	2.67
+ 16.00	27	53	81	1.11	1.39	1.71	2.03	2.35	2.71	3.07

Distance Compensation Table (with - Sphere)

PHOROPTOR Reading	Distance									
	1mm	2mm	3mm	4mm	5mm	6mm	7mm	8mm	9mm	10mm
- 1.00	001	002	003	004	005	006	007	008	009	01
- 2.00	01	01	02	02	02	03	03	03	04	04
- 3.00	01	02	03	04	04	05	06	07	08	09
- 4.00	02	03	05	06	08	09	11	12	14	15
- 5.00	03	05	07	10	12	15	17	19	22	24
- 6.00	04	07	10	15	17	22	25	28	31	35
- 7.00	05	10	14	20	24	30	33	38	42	47
- 8.00	06	13	19	25	31	38	42	49	54	60
- 9.00	08	16	24	31	39	47	53	61	67	74
- 10.00	10	20	30	38	48	57	65	74	82	90
- 11.00	12	24	36	46	57	68	79	88	99	1,08
-12.00	14	28	42	55	67	80	93	1.04	1.17	1,28
-13.00	16	33	48	64	78	94	1.08	1.22	1.36	1.49
-14.00	19	38	55	74	90	1.08	1.24	1.41	1.56	1.71
-15,00	22	43	63	85	1.03	1.23	1.41	1,61	1.78	1.95
-16.00	25	49	72	96	1.17	1.39	1.60	1.82	2.01	2.20
-17.00	28	55	81	1.08	1.32	1.56	1.80	2.04	2.25	2.46
-18.00	31	62	91	1.2]	1.48	1.74	2.0)	2,27	2.50	2.73
-19.00	35	69	1.02	1.34	1.65	1.93	2.25	2.51	2.77	3.02

17. Specifications

Sphere powers range	+ 16.75D to -19.00D, with minimum reading 0.25D or 0.12D (when 0.12D auxiliary lens or optional ±0.12D lens is in use) + 26.75D to -29.00D (when optional +10.00D lens is in use)
Cylinder powers range	0 to -6.00D, with minimum reading 0.25D or 0.12D (when auxiliary lens is in use) 0 to -8.00D (when -2.00D auxiliary lens is in use)
Astigmatic axis scale	0 to 180° in 5° steps
Cross cylinder	±0.25D, reversal type (synchronized with astigmatic axis) ±0.50D optional
Rotary prism	0 to 20Δ D in 1Δ D step
Auxiliary lens	

Right eye	Left eye
O (Open aperture) OC (Occluder) +50 (Fixed cross cylinder)	
6Δ U (6 prism dioter base Up)	10Δ I (10 prism diopter base In)
PH (Pinhole) + 12 (+0.12D sphere lens)	

RL (Red filter) RMH (Red maddox rod, horizontal) RMV (Red maddox rod, vertical)	GL (Green filter) WMH (White maddox rod, horizontal) WMV (White maddox rod, vertical)
P45°(Polarizing filter, axis 45°) P135°(Polarizing filter, axis 135°) R (Retinoscopic lens. +2.00D, for 50cm)	

Interpupillary adjustment	48mm to 80mm in 1mm step (right and left synchronized)
Forehead rest adjustment	16mm backward and forward
Convergence	The optical axes of the lenses are aligned at a distance of 400mm from the vertexes of the corneas (2mm each for right and left inward) Interpupillary distance enabling convergence = 57mm to 80mm
Corneal distance device	2mm forward and 5mm backward from standard plane; with scale
Effective field of view	19mm

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